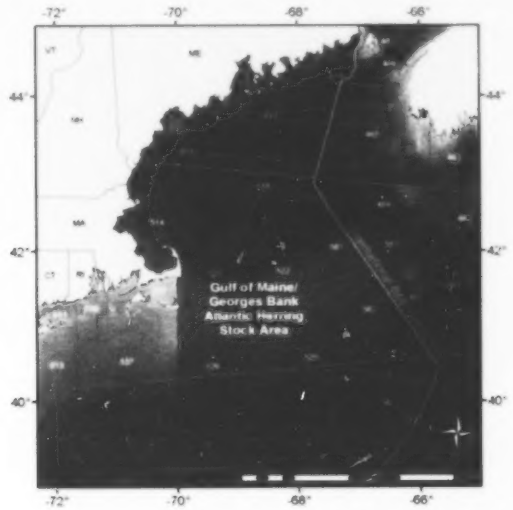
Fisheries and Oceans Canada | Pêches et Océans Canada | NOAA FISHERIES NATIONAL MARINE FISHERIES SERVICE

Transboundary Resource Assessment Committee

Status Report 2006/01

GULF OF MAINE-GEORGES BANK HERRING STOCK COMPLEX



Summary

- Combined Canada and USA herring landings increased from 106,000 mt in 2002 to 110,000 mt in 2003, increased further to 115,000 mt in 2004, and declined to 105,000 mt in 2005.

- **Stock biomass (2+)** increased from about 105,000 mt in 1982 to about 1.3 million mt in 2000. Subsequently, biomass has declined slightly and was 1.0 million mt in 2005.

- **Recruitment** at age 2 increased in the late 1980s with several moderate year classes. In the past decade, three very large year classes have been produced (the 1994, 1998, and 2002 cohorts).

- **Fishing mortality (age 2+)** declined from peak values above 0.70 in the 1970s to an average of 0.30 during the mid-late 1980s (Figure 1). Fishing mortality declined to 0.15 in 1991 and has remained at about 0.1 since 2002 (Figure 1).

- Assuming that fishing mortality in 2006 is equal to that in 2005 (F=0.11) produces a catch in 2006 of 105,000 mt (the same catch as in 2005). The resulting SSB in 2007 would be 952,000 mt, a decline of about 6%. Assuming average recruitment in 2006 through 2008, continuing to fish at F=0.11 in 2007 would generate a catch in 2007 of 99,000 mt and SSB in 2008 would be 901,000 mt.

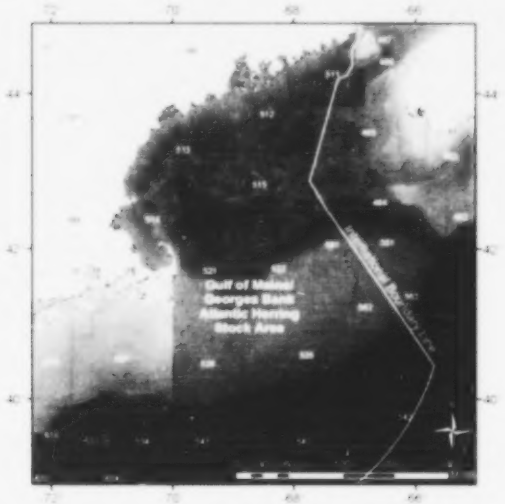
- The relative proportion of the inshore component of the overall herring stock complex was 18% based on the average proportion from three different data sources (commercial acoustic survey biomass estimates; morphometric studies; and NEFSC autumn survey swept biomass estimates).

Fisheries and Oceans Canada | Pêches et Océans Canada | NOAA FISHERIES

Transboundary Resource Assessment Committee

Status Report 2006/01

GULF OF MAINE-GEORGES BANK HERRING STOCK COMPLEX



Summary

- Combined Canada and USA herring landings increased from 106,000 mt in 2002 to 110,000 mt in 2003, increased further to 115,000 mt in 2004, and declined to 105,000 mt in 2005.

- **Stock biomass (2+)** increased from about 105,000 mt in 1982 to about 1.3 million mt in 2000. Subsequently, biomass has declined slightly and was 1.0 million mt in 2005.

- **Recruitment** at age 2 increased in the late 1980s with several moderate year classes. In the past decade, three very large year classes have been produced (the 1994, 1998, and 2002 cohorts).

- **Fishing mortality (age 2+)** declined from peak values above 0.70 in the 1970s to an average of 0.30 during the mid-late 1980s (Figure 1). Fishing mortality declined to 0.15 in 1991 and has remained at about 0.1 since 2002 (Figure 1).

- Assuming that fishing mortality in 2006 is equal to that in 2005 (F=0.11) produces a catch in 2006 of 105,000 mt (the same catch as in 2005). The resulting SSB in 2007 would be 952,000 mt, a decline of about 6%. Assuming average recruitment in 2006 through 2008, continuing to fish at F=0.11 in 2007 would generate a catch in 2007 of 99,000 mt and SSB in 2008 would be 901,000 mt.

- The relative proportion of the inshore component of the overall herring stock complex was 18% based on the average proportion from three different data sources (commercial acoustic survey biomass estimates; morphometric studies; and NEFSC autumn survey swept biomass estimates).

Landings, 2+ biomass (thousands mt), Recruits (billions)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Avg[1]	Min[1]	Max[1]
Canada Landed	18	21	20	19	17	24	13	11	21	13	23	9	39
USA Landed	109	99	106	106	109	108	93	101	94	92	69	25	109
Total Landed	127	120	126	125	126	133	107	110	115	105	93	36	133
2+ Biomass	999	1013	1034	1032	1291	1261	1094	1076	1122	1040	628	105	1432
Age 2 Recruits	7.223	3.068	2.978	1.768	5.52	1.158	1.52	2.411	4.768	1.483	2.3	0.409	8.086
Fishing Mortality	0.15	0.13	0.1	0.12	0.1	0.13	0.11	0.11	0.11	0.11	0.34	0.1	0.81
Exploitation Rate	14%	12%	10%	12%	10%	12%	10%	10%	10%	10%	29%	10%	52%

1 Data for landings (thousands mt) is from 1978-2005, for 2+ biomass (thousands mt), recruitment (billions), and F (2+) from 1967-2005.

Fishery

Combined Canada/USA landings. Combined Canada/USA landings averaged 77,000 mt during 1978-1994 (Figure 1). Landings increased during 1995-2001, averaging 123,000 mt, and peaking at 133,000 mt in 2001. Landings declined slightly during 2002-2005, and averaged 109,000 mt. During 1978-2005, the USA accounted for about 72% of the total landings, but during the most recent decade, this percentage increased to about 85%.

Canadian landings. Landings by Canada averaged about 27,000 mt during 1978-1994, declined to an average of 19,000 mt during 1995-2001, and declined further to 14,000 mt during 2002-2005. Canadian landing have been dominated by the New Brunswick weir fishery, with small contributions from cove shutoff fisheries in southwest Nova Scotia and mid-water trawl landings on Georges Bank.

USA landings. Landings by the United States averaged about 49,000 mt during 1978-1994, increased to an average of 103,000 mt during 1995-2001, and declined to an average of 95,000 mt during 2002-2005. During 1978-1982, USA landings were about equally split between the weir fisheries and purse seines. During 1983-1992, most USA landings were taken by purse seines but subsequently single mid-water and paired mid-water trawling have dominated the landings, with purse seining accounting for only about 10-15% of the total USA landings during 2000-2005. The USA Georges Bank mid-water trawl fishery began in 1994, peaked at 35,000 mt in 2001 and averaged about 13,000 mt during 1994-2005.

Harvest Strategy & Reference Points

The Atlantic herring TRAC recommends that a strategy be adopted to maintain a low to neutral risk of exceeding the fishing mortality limit reference point, and that when stock conditions are poor, fishing mortality rates should be further reduced to promote rebuilding. A Fox surplus production model estimated F_{msy} = 0.31, MSY = 194,000 mt, and Bmsy = 629,000 mt (Figure 4). Yield per recruit reference points (proxies for Fmsy) were estimated as: F0.1=0.21, and F40%=0.20.

State of Resource

The state of the resource was based on results from an age-structured, analytical assessment which used fishery catch statistics and biological samples to characterize the size and age composition of the catches during 1967 to 2005. Several model formulations were considered, all of which give similar trends in stock size but differed in scale. The final model formulation was selected, with some difficulty, to balance various data sources and their uncertainty, and was calibrated to trends in abundance from the NMFS spring, fall and winter bottom trawl surveys, as well as the NMFS hydroacoustic survey.

Retrospective analyses were used to detect any patterns to overestimate - or underestimate - fishing mortality, biomass and recruitment relative to the terminal year estimates. A significant retrospective pattern was detected in this assessment in overestimating SSB (averaging + 14.5%/year, and ranging between 1-24%) and this is a concern. The pattern has persisted for several years and is expected to continue in the future.

Stock biomass (2+) increased steadily from about 105,000 mt in 1982 to nearly 1.3 and was estimated to be 1.0 million mt at the beginning of 2005. Biomass increases in the late 1990s were due to improved recruitment, especially from two very large year classes, 1994 and 1998 (Figure 2). Weights-at-age in the population declined in the late 1980s but have remained steady since 1995.

Recruitment (at age 2) markedly improved in the late 1980s with several moderate year classes and three very large year classes (1994 cohort: 7.2 billion; 1998 cohort: 5.5 billion; and the 2002 cohort: 4.8 billion). Recruitment from the 1999-2000 and 2003 year classes all appear weaker than the long-term (1967-2005) average of 2.3 billion fish.

Fishing mortality (age 2+) declined from peak values above 0.7 in the 1970s to an average of 0.3 during the mid-late 1980s (Figure 1). Fishing mortality declined to 0.15 in 1991 and has remained stable at about 0.1 from 2002 onwards (Figure 1).

Productivity

Age structure, spatial distribution, and fish growth reflect changes in the productive potential of the stock complex. The **population age structure** displays an increasing presence of older age groups since 1995, consistent with lowered exploitation levels. Increasing abundance of older fish in the catch-at-age and future surveys would help to confirm this pattern. **Spatial distribution** patterns of herring in the most recent NMFS fall bottom trawl surveys (1998-2005) were similar to patterns observed in the 1960s, prior to the collapse of the offshore stock component. Declines in **weights-at-age** are a factor in limiting increases in the population biomass, and **predator consumption** estimates of herring have increased since the mid-1980s. On balance, however, the productive potential of the herring stock complex has improved in recent years.

Outlook

An outlook is provided in terms of the consequences on SSB and for yield in 2006, 2007 and 2008 of maintaining the current (2005) fishing mortality rate (F=0.11). Although uncertainty in stock size and recruitment generates uncertainty in forecast results, a formal risk analysis was not undertaken due to the significant retrospective pattern in SSB and the difficulty and uncertainty in selecting the final model formulation. Nevertheless, the forecasts are considered useful for general management guidance.

The projections assumed that recruitment of the 2004-2006 year classes was equal to the long-term average (2.3 billion fish at age 2) (Figures 2 and 3). A fishing mortality of F=0.11 in 2006 generates a catch of 105,000 mt (equal to the 2005 landings) and an SSB in 2007 of 952,000 mt, a decline of about 6%. Continuing to fish at F=0.11 in both 2007 and 2008 produces annual catches of 99,000 mt and 94,000 mt, respectively, and results in a slight decline in SSB in 2008 to 901,000 mt.

SSB, Yield (thousands mt)

	SSB	*Yield*	F
2006	1008	105	0.11
2007	952	99	0.11
2008	901	94	0.11

Special Considerations

The 2002 year class will dominate catches in 2006 and 2007, although the 1998 will still be important. Catches over the next several years are therefore dependent on the magnitude of the 2002 year class, which still has high uncertainty.

The retrospective pattern in SSB that has been apparent during the last several years should be considered. Ignoring the retrospective pattern in biomass could increase the risk of not meeting conservation objectives.

An investigation of natural mortality rates used in the model indicated that a rate higher than the assumed M=0.2 (*i.e.*, M=0.3-0.4) was more consistent with the available data.

Relative Proportion of Inshore Component

Three data sources were examined to investigate the relative proportion of the inshore component within the overall herring stock complex. Commercial acoustic estimates of biomass during 1999-2000 suggested that the average proportion on the inshore component was about 10%. Morphometric analyses of four samples of herring obtained during 2005 in the winter fishery area from Long Island to Marthas Vineyard indicated an average inshore proportion of about 13%. Swept area biomass estimates from the NMFS autumn survey estimated the inshore component to be about 30% of the total complex. The average of these three estimates is 18%.

Source Documents

Overholtz, W.D., L.D. Jacobson, G.D. Melvin, M. Cieri, M. Power, D. Libby, and K. Clark. 2004. Stock assessment of the Gulf of Maine-Georges Bank Atlantic herring complex, 2003. Northeast Fisheries Science Center Reference Document 04-06, 290 p.

Correct Citation

TRAC, 2006. Gulf of Maine-Georges Bank Herring Stock Complex. TRAC Status Report 2006/01.

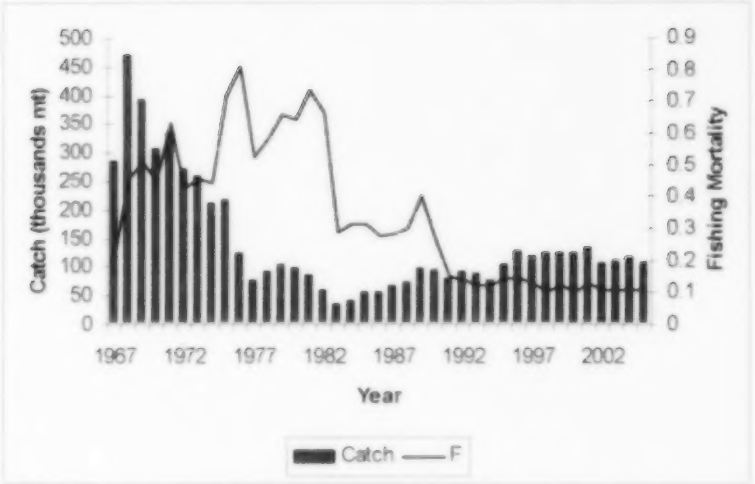


Figure 1. Landings and Age 2+ fishing mortality.

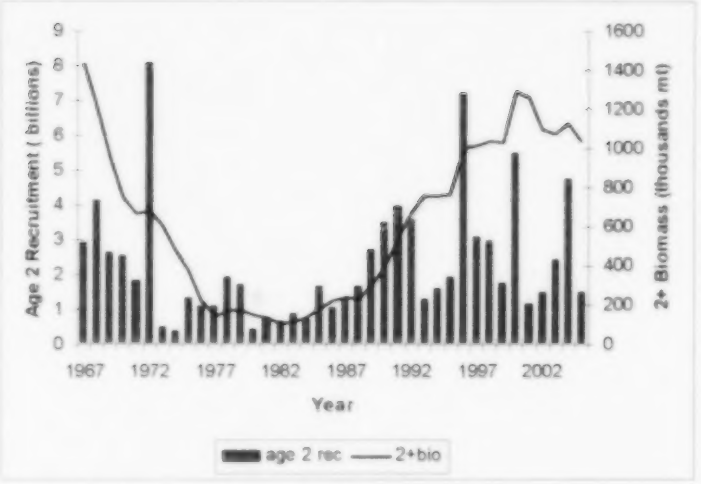


Figure 2. Age 2+ biomass and Age 2 recruitment.

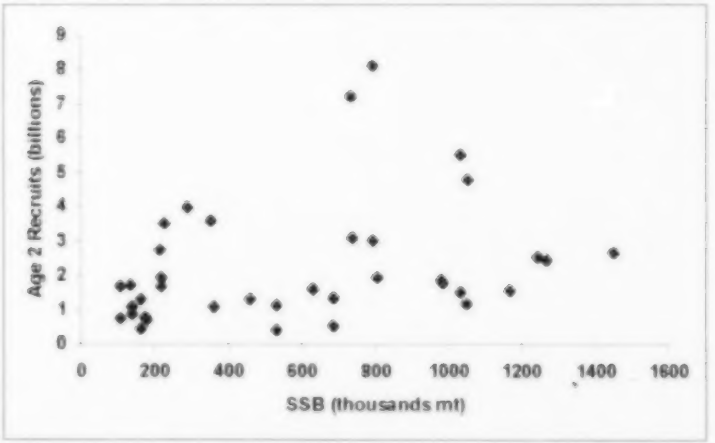


Figure 3. SSB and Age 2 recruitment.

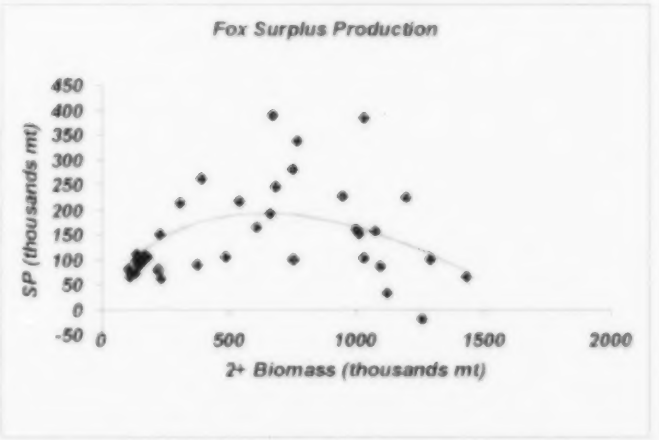


Figure 4. Age 2+ biomass and surplus production.